



一门科学只有在成功地运用数学时，  
才算达到了真正完善的地步。

——马克思



QK1936373

# 数学的实践与认识

MATHEMATICS

IN PRACTICE AND THEORY

第四十九卷

Vol. 49

第13期

No.13

2019

中国数学会会刊  
中国科学院数学与系统科学研究院主办  
科学出版社出版

# 数学的实践与认识

2019年第49卷第13期

## 目 次

### 管理科学

- 基于模糊厌恶视角的最优固定利率与可变利率贷款组合决策行为研究 ..... 李华文, 程文 (1)  
基于复合分类法的特色旅游小镇开发空间结构特征研究——以上海市为例 .....  
徐薛艳, 尚欣宇, 谢鹏扬, 张中浩 (9)  
基于策略型消费者购买习惯的产品动态定价决策研究 ..... 冯健, 刘斌, 刘振锋 (18)  
促进中国再生能源产业发展的整合性政策工具——以风能产业为例 ..... 高建刚, 杨娜 (30)  
基于消费者价值的打车出行服务竞争策略研究 ..... 杨浩雄, 付朋霞 (43)  
考虑用户沟通成本的物流服务团购策略 ..... 丁雪峰, 胡衡, 高攀 (53)  
长江经济带经济发展质量的演化趋势与对策研究 ..... 范金, 万伟, 袁小慧 (61)  
集体土地作价入股农业特色小镇路径演化分析 ..... 顾海蔚, 宋宏 (73)  
基于熵权法的农产品流通效率模糊综合评价研究——以河南省为例 .....  
武孟飞, 李炳军, 魏新娟, 杨卫明 (83)

- 气象灾害下电力系统应急保障能力风险评估 ..... 范文佳, 李金林, 白鹏飞, 李皓 (94)  
基于前景理论的三参数区间灰数信息下多属性灰关联决策方法 ..... 张东兴, 王建平, 李晔 (101)  
公平偏好下双渠道旅游供应链运作策略研究 ..... 郭金森, 周水务, 任鸣鸣, 海本禄 (109)  
基于灰数距离熵的四参数区间数的 TOPSIS 模型及实证分析 ..... 张文林, 孙新杰, 张慧恩, 宁宝权 (120)  
轨道交通建设 PPP 模式公私双方策略选择问题研究——基于演化博弈理论 ..... 郭菲菲, 黄承锋 (129)

### 工 程

- 机器学习方法在储层分类中的应用 ..... 干磊, 何东博, 郭建林, 孟凡坤 (138)

### 应 用

- 具有延迟休假和  $\text{Min}(N, V)$ -策略控制的  $M/G/1$  排队的瞬态队长分布 ..... 胡蓉, 唐应辉 (145)  
稳健 AR 模型的构建及比较研究 ..... 王志坚, 王斌会 (156)  
基于新的 Hessian 近似矩阵的稀疏重构算法 ..... 刘泽显, 刘红卫, 何川美 (167)  
基于动态无偏灰色马尔科夫模型的煤炭需求量预测 ..... 索瑞霞, 王翔宇, 沈剑 (179)  
一类系数为梯形模糊数的两层多随从线性规划模型 ..... 周喜华, 黄晓红, 石盟盟, 邓胜岳, 杨培 (187)  
巴丹吉林沙漠东缘不同粒级砂土空间分布的多重分形研究 .....  
解云, 目世杰, 孙鹏哲, 刘红梅, 刘清泉, 王玉芝 (194)

- 基于深度残差网络的水下海参自动识别研究 ..... 郭祥云, 王文胜, 刘亚辉, 张航, 乔曦 (203)

### 研 究

- (2+1) 维耗散长波方程的新精确解及其演化 ..... 杨娟, 曾春花 (213)  
几乎强正则环及其扩张 ..... 王尧, 杨圳, 任艳丽 (219)  
Dirichlet 级数的广义 Hadamard 商的增长性 ..... 崔永琴, 徐会清, 徐洪焱 (225)  
关于丢番图方程  $x^2 + y^2 = p$  与  $x^2 + 2y^2 = p$  的整数解 ..... 汤健儿, 何其祥 (230)  
向量参变量的约束集族最大元的通有稳定性 ..... 卢美华, 肖莉娜, 左勇华 (239)  
否定非对合剩余格的 BF- 理想 ..... 刘春辉, 姜志廷, 秦学成 (245)  
一类分数阶超混沌系统修正函数投影同步的滑模控制 ..... 耿彦峰, 王立志, 刘芳 (252)  
 $M$ -矩阵 Fan 积最小特征值的不等式 ..... 黄宽娜, 刘徽, 韩仲明 (259)  
一类三变量非线性和差分不等式中未知函数的估计 ..... 陈立强, 王五生 (265)  
一类不确定随机非线性系统的采样扩张状态观测器设计与观测误差的收敛性分析 .....  
吕春婉, 任寒景, 欧阳正勇, 陈剑, 吴泽浩 (273)

### 教学研究

- 智能技术创新网络下企业行为决策的演化博弈分析 ..... 陈璐, 孙圣兰, 陈雯 (284)  
FDI、资本效应、技术溢出效应与江苏服务业增长——基于结构方程模型的实证研究 .....  
卢丹, 王英, Hashim Zameer, 施鹏程 (290)  
“水稻供应商 + 水稻加工企业”的优质稻米供给决策研究 ..... 高艳, 张宏宇 (299)  
大数据处理中分类算法的数值比较 ..... 李晓霞, 程伟丽, 张雷, 张朝阳 (308)  
具有次线性中立项的二阶半线性微分方程的振动准则 ..... 李文娟, 李书海 (315)  
基于疫病检测信息的布病动力学模型分析 ..... 乔瑞春, 侯强, 李有文 (322)

# MATHEMATICS IN PRACTICE AND THEORY

2019 Vol.49 No. 13

## Contents

### Managed Science

- The Research on Decision-Making Behaviors of Optimal Fixed and Variable Rate Loan Portfolio Based on The View of Ambiguity Aversion ..... LI Hua-wen, CHENG Wen (1)
- A Compound Classification Approach for the Spatial Structure of Developing Tourist Town in shanghai ..... XU Xue-yan, SHANG Xin-yu, XIE Peng-yang, ZHANG Zhong-hao (9)
- Dynamic Pricing Decision of Products Considering the Presence of Strategic Consumers' Shopping Habit ..... FENG Jian, LIU Bin, LIU Zhen-feng (18)
- Integrated Policy Instruments Promoting the Development of Renewable Energy Industry — The case of wind energy ..... GAO Jian-gang, YANG Na (30)
- Research on Competitive Strategy of Taxi Travel Service Based on Consumer Value ..... YANG Hao-xiong, FU Peng-xia (43)
- Group Buying Strategy of Logistics Service Considering Customers's Communication Cost ..... DING Xue-feng, HU Heng, GAO Pan (53)
- A Research on the Economic Development Quality in the Yangtze River Economic Belt the Trend and Countermeasures ..... FAN Jin, WAN Wei, YUAN Xiao-hui (61)
- Evolution Analysis of Path of Agricultural Characteristic Towns with Collective Land Price as Share ..... GU Hai-wei, SONG Hong (73)
- Research on Fuzzy Comprehensive Evaluation of Agricultural Products Circulation Efficiency Based on Entropy Weight Method — Taking Henan province as an example ..... WU Meng-fei, LI Bing-jun, WEI Xin-juan, YANG Wei-ming (83)
- Risk Assessment of Emergency Support Capability for Power System Under Meteorological Disasters ..... CHEN Wen-jia, LI Jin-lin, BAI Peng-fei, LI Hao (94)
- Multi-attribute Grey Relational Decision-making Method with Three-parameter Interval Grey Number Based on Prospect Theory ..... ZHANG Dong-xing, WANG Jian-ping, LI Ye (101)
- Research on the Operation Strategy of Dual-channel Tourism Supply Chain Based on Fairness Preference ..... GUO Jin-sen, ZHOU Yong-wu, REN Ming-ming, HAI Ben-lu (109)
- The TOPSIS Model and Empirical Analysis of Interval Numbers of Four Parameters Based on Gray Number Distance Entropy ..... ZHANG Wen-lin, SUN Xin-jie, ZHANG Hui-yuan, NING Bao-quan (120)
- Analysis of Public Private Partnership in Rail Transit Construction Based on Evolutionary Game ..... GUO Fei-fei, HUANG Cheng-feng (129)

### Engineering

- Application of Machine Learning Method in Reservoir Classification ..... GAN Lei, HE Dong-bo, GUO Jian-lin, MENG Fan-kun (138)

### Applications

- The Transient Queue Length Distribution of  $M/G/1$  Queueing System with Delayed Vacation and  $\text{Min}(N, V)$ -policy ..... HU Rong, TANG Ying-hui (145)
- The Formation and Comparison of Robust AR model ..... WANG Zhi-jian, WANG Bin-hui (156)
- The Sparse Reconstruction Algorithm Based on a New Scalar Approximation to the Hessian Matrix ..... LIU Ze-xian, LIU Hong-wei, HE Chuan-meii(167)
- Prediction of China's Coal Demand Based on Dynamic Unbiased Grey Markov Model ..... SUO Rui-xia, WANG Xiang-yu, SHEN Jian (179)
- Bi-level Linear and Multiple Followers Programming Model of a Class of Coefficients for Trapezoidal Fuzzy Numbers ..... ZHOU Xi-hua, HUANG Xiao-hong, SHI Meng-meng, DENG Sheng-yue, YANG Pei (187)
- Multifractal Analysis of Spatial Distribution of Different Grained Sand in the Eastern Margin of the Badain Jaran Desert ..... XIE Yun, LV Shi-jie, SUN Peng-zhe, LIU Hong-meii, LIU Qing-quan, WANG Yu-zhi (194)
- Automatic Recognition of Underwater Sea Cucumber Based on Resnet ..... GUO Xiang-yun, WANG Wen-sheng, LIU Ya-hui, ZHANG Hang, QIAO Xi (203)

### Research

- New Exact Solutions and Soliton Evolvements for the (2+1)-dimensional Dispersive Long Wave Equation ..... YANG Juan, ZENG Chun-hua (213)
- Almost Strongly Regular Rings and Their Extensions ..... WANG Yao, YANG Zhen, REN Yan-li (219)
- The Growth of the Generalized Hadamard Quotient of Dirichlet series ..... CUI Yong-qin, XU hui-qing, XU Hong-yan (225)
- On the Integer Solutions of Diophantine Equations  $x^2 + y^2 = p$  and  $x^2 + 2y^2 = p$  ..... TANG Jian-er, HE Qi-xiang (230)
- On the Generic Stability of the Constrained Largest Element of a Set Family with Vector Parameter ..... LU Mei-hua, XIAO Lina, ZUO Yong-hua (239)
- BF-ideals in Negative Non-involutive Residuated Lattices ..... LIU Chun-hui, JIANG Zhi-ting, QIN Xue-cheng (245)
- Modified Function Projective Synchronization by Sliding Mode Control for a Class of Fractional-order Hyper Chaotic Systems ..... GENG Yan-feng, WANG Li-zhi, LIU Fang (252)
- Some Inequalities on Minimum Eigenvalue for the Fan Product of M-matrices ..... HUANG Kuan-na, LIU Hui, HAN Zhong-ming (259)
- Estimation of Unknown Functions in a Class of Nonlinear Sum-Difference Inequalities in Three Independent Variables ..... CHEN Li-qiang, WANG Wu-sheng (265)
- Design of Sampled Extended State Observer for a Class of Uncertain Stochastic Nonlinear Systems and Convergence Analysis of Observation Errors ..... LV Chun-wan, REN Han-jing, OUYANG Zheng-yong, CHEN Jian, WU Ze-hao (273)

### Teaching Research

- The Evolutionary Game Analysis of the Sharing of Intelligent Technology Resource Behavior Under the Innovation Network ..... CHEN Lu, SUN Sheng-lan, CHEN Wen (284)
- FDI, Capital Effect, Technology Spillover Effect and the Services Growth in Jiangsu Province— An empirical study based on structural equation model ..... LU Dan, WANG Ying, Hashim Zameer, SHI Peng-cheng (290)
- Study on Supply Decision of High Quality Rice for "Rice Supplier + Rice Processing Enterprise" ..... GAO Yan, ZHANG Hong-yu (299)
- Numerical Comparison of Classification Algorithms in Big Data Analysis ..... LI Xiao-xia, CHENG Wei-li, ZHANG Lei, ZHANG Chao-yang (308)
- Oscillation Criteria for Second Order Half-linear Differential Equations with Sublinear Neutral Term ..... LI Wen-juan, LI Shu-hai (315)
- Analysis of Brucellosis Dynamic Model Based on Disease Detection Information ..... QIAO Rui-chun, HOU Qiang, LI You-wen (322)

# 《数学的实践与认识》编辑委员会

主编：林群

副主编：(以下按姓氏笔划为序)

卢焱 叶其孝 朱广田(常务副主编)

李邦河 汪寿阳 宋春伟 张继平

编委：王术 王冬琳 王建明 龙永红 叶专

史福贵 冯荣权 朱一心 许进 李宁

余志坤 张文岭 林源渠 郑连存 姜启源

骆顺龙 贾仲孝 郭懋正 唐仲伟 黄海洋

常彦勋

## 数学的实践与认识

Shuxue de Shijian yu Renshi

(半月刊)

第49卷

第13期

2019年7月

Journal of Mathematics in Practice and Theory

(Semimonthly)

Vol.49 No.13 August 2019

编 辑 中国数学会  
《数学的实践与认识》编委会  
北京大学数学科学学院  
邮政编码：100871  
电 话：(86-10)62759981  
电子邮件：bjmath@math.pku.edu.cn

Edited by

Editorial Board of  
Mathematics in Practice and Theory  
School of Mathematical Sciences, PKU  
Beijing 100871, China  
Tel:(86-10)62759981  
Email:bjmath@math.pku.edu.cn

主 编 林群  
主管单位 中国科学院  
主办单位 中国科学院数学与系统科学研究院  
承办单位 中国科学院系统科学研究所

Editor in Chief

LIN Qun  
Chinese Academy of Sciences  
Academy of Mathematics and  
Systems Science, Chinese Academy  
of Sciences

北京数学会  
出 版 社 学 术 出 版 社  
北京东黄城根北街16号  
邮政编码：100717

Co-sponsored by

Institute of Systems Science, Academy of  
Mathematics and Systems Science,  
Chinese Academy of Sciences  
Beijing Mathematical Society  
Science Press

印 刷 中国文联印刷厂  
国 内 发 行 北京市邮局  
国 外 发 行 中国国际图书贸易总公司  
(北京399信箱)  
国 内 订 购 全国各地邮局  
网 址 <http://ssjs.cbpt.cnki.net>

Published by

16 Donghuangchenggen North Street,  
Beijing 100717, China  
Printing House of Wenlian in China  
Beijing Post Office  
China International Book Trading  
Corporation (CIBTC) P.O.Box 399,  
Beijing, China  
All Local Post Office

(如有印装质量问题，印刷厂负责调换电话010-68431909)

ISSN 1000-0984

国外发行代号Q47

CN11-2018/O1

国内发行代号2-809

定 价：人民币30.00元

ISSN 1000-0984



13>  
9 771000 098199